Multidisciplinary Teaming Studies

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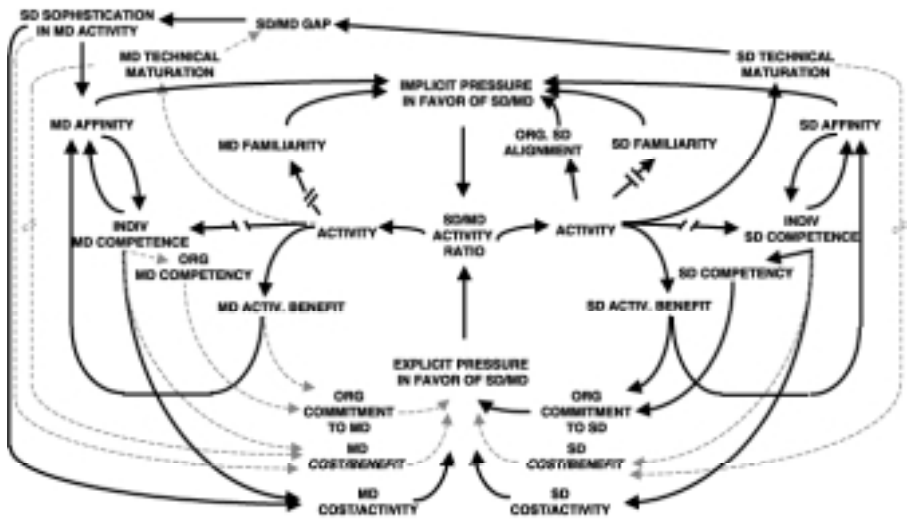
ETPS

	Team Approach to the Problem or Task		Team Leadership		Coordination of Task Responsibilities		Organizational Support		Communication & Feedback		Team Roles & Norms		Your Role on the Team		
Code	1 & 2	4 & 5	1 & 2	4 & 5	1 & 2	4 & 5	1 & 2	4 & 5	1 & 2	4 & 5	1 & 2	4 & 5	1 & 2	4 & 5	
Sum															Total
Avg. 1 & 2															
Avg. 4 & 5															

System Thinking



Background

- MDO research applications at NASA LaRC involve multi-disciplinary, multi-organizational research teams
- Many participants on these MDO teams came from a background in which they worked individually or with 1 or 2 collaborators
- Most researchers are very uncomfortable depending on someone else in order to get their job done
- Most branches are reluctant to play a supporting role in a project
- During 1996-98 MDOB facilitated 2 studies of the issues facing such teams
  - Engineering Team Dynamics
  - Systems Thinking Applied to Multidisciplinary Teams
- 3 papers on the results were presented at the 1998 MA&O Symposium

Team Study Participants & Sponsors

- Engineering Team Dynamics
  - Funding provided by 4 Divisions (Aero & Gas Dynamics, Fluid Mechanics & Acoustics, Flight Dynamics, Materials)
  - Surveys covered participants from 6 Divisions (4 above plus Aerospace Systems Analysis, Space Systems Concepts)
- System Thinking
  - Consulting fees for Innovation Associates covered by Research & Technology Group
  - Study participants came from 4 Divisions (Aero & Gas Dynamics, Fluid Mechanics & Acoustics , Flight Dynamics, Structures)

Engineering Team Study

- Clemson University received a NASA Multidisciplinary Design and Analysis Fellowship Program award for 1994-97
- Prof. Ron Nowaczyk of Clemson did the academic team studies under this grant
- Prof. Nowaczyk spent a sabbatical at LaRC from 9/96 to 8/97 studying LaRC engineering teams
- Phase I (9/96 - 3/97) determined the primary factors affecting engineering teams
- Phase II (4/97 - 8/97) developed and validated a survey instrument as well as an intervention manual
- Subsequently, the survey was implemented as a web-based form
- This study was coordinated by Thomas Zang

Observations from Team Dynamics Study

- Virtually all of the research underlying current theories of teams is based on teams of managers performing management tasks
- Only 1 major study (1965) has focused on teams of engineers performing engineering tasks
- This LaRC study indicated that engineering teams at NASA Langley, as opposed to management teams in general
  - are more likely to have the necessary skills to perform the task
  - have greater difficulty in deciding the approach to the task

Engineering Team Performance Scale

- The result of this Engineering Team Dynamics study was the Engineering Team Performance Scale (ETPS)
- This is a survey instrument to evaluate the effectiveness of a team
- The ETPS was developed after the characteristics of successful and unsuccessful teams were identified
- The survey contains 29 items based on 7 dimensions
  - Team Approach to Problem or Task
  - Team Leadership
  - Task Coordination
  - Organizational Support
  - Communication & Feedback
  - Team Roles & Norms
  - Personal Performance on Team

2 of 4 Questions from "Organizational Support for the Team"

15. What was the role of the team sponsor?

- (●) The team sponsor appeared to discourage team activities or did not believe in the team mission.
- ( ) The team sponsor provided little visible support and viewed the team primarily as "another one of his/her many responsibilities."
- ( ) The team sponsor's level of oversight did not hinder nor enhance the team's activities.
- ( ) The team sponsor took a "hands-off" approach with the team unless asked to intervene on behalf of the team.
- ( ) The team sponsor was clearly a "champion" for the team and its work.

16. What was the team's perception of its value within the organization?

- (●) Team members held differing opinions about the team's value to the organizational mission.
- ( ) Most team members felt the team's contribution to the organizational mission would be minimal.
- ( ) Aspects of the team's work appeared to be important within segments of the organization.
- ( ) Most team members could see that the team's activities were important to the organization overall.
- ( ) The team was of "one mind" in that its work was important to the organizational mission.

Scoring & Use of the ETPS

- Calculate the Mean Rating per Item

Successful Team

5 or less “1& 2” Ratings

18 or more “4 & 5” Ratings

10 or more “1& 2” Ratings

12 or less “4 & 5” Ratings

Unsuccessful Team

- An intervention manual has been developed that contains recommended exercises to improve weak dimensions identified by the ETPS

Comments on Team Dynamics Study

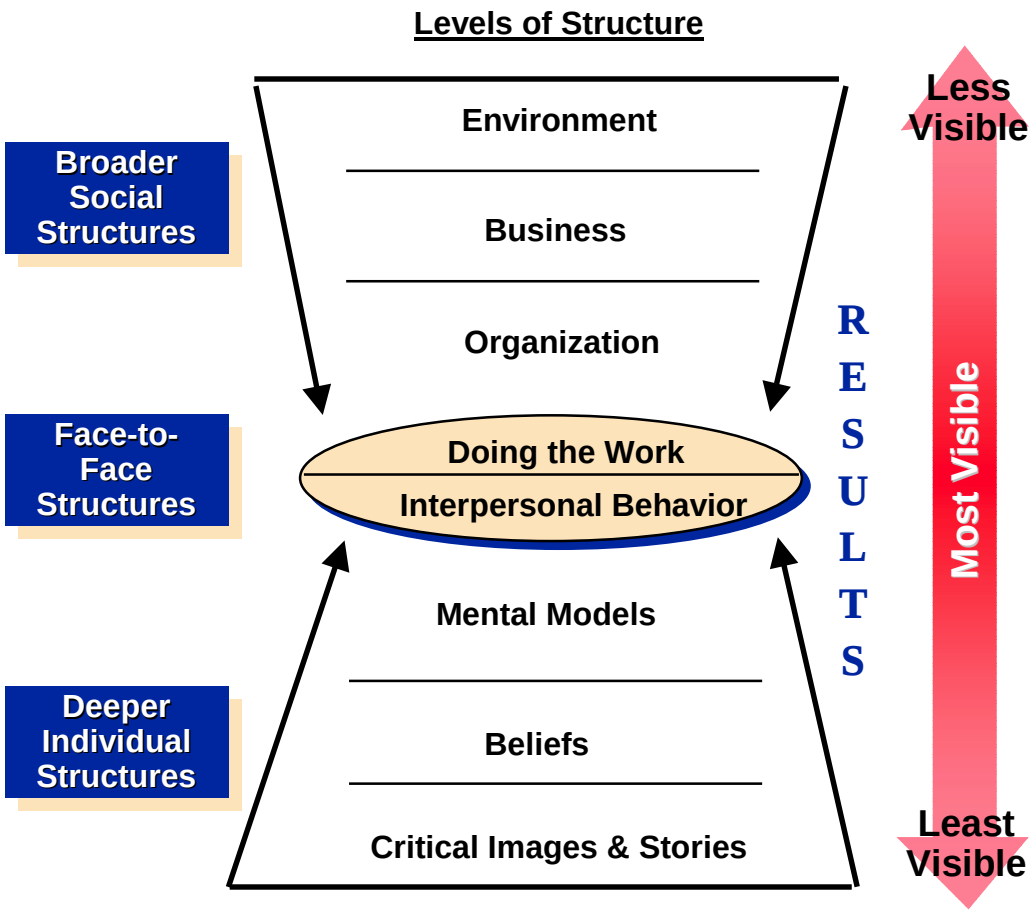
- Engineering teams, as opposed to management teams
  - are more likely to have the necessary skills to perform the task
  - have greater difficulty in deciding the approach to the task
- The ETPS is a reliable instrument for assessing the performance and identifying areas of improvement
- The ETPS can be filled out on the web in 15-20 minutes
- The ETPS can be used during a team's lifetime and/or at its conclusion

Systems Thinking Study Objectives

- NASA Langley's Research & Technology Group made a significant investment in having 300 of the staff trained in Systems Thinking in 1995-97
- Multidisciplinary Team objectives of study
  - Identify barriers to success for multidiscipline research teams at NASA Langley
  - Develop recommendations that will help multidiscipline teams to be more effective
- System Thinking training objectives of study
  - Develop a Langley-based application of systems thinking to a real, practical, and significant issue
  - Document the effort in a case study to be available for training and a reference for future efforts
- This study was led by Jean-François Barthelemy

Systems Thinking Overview

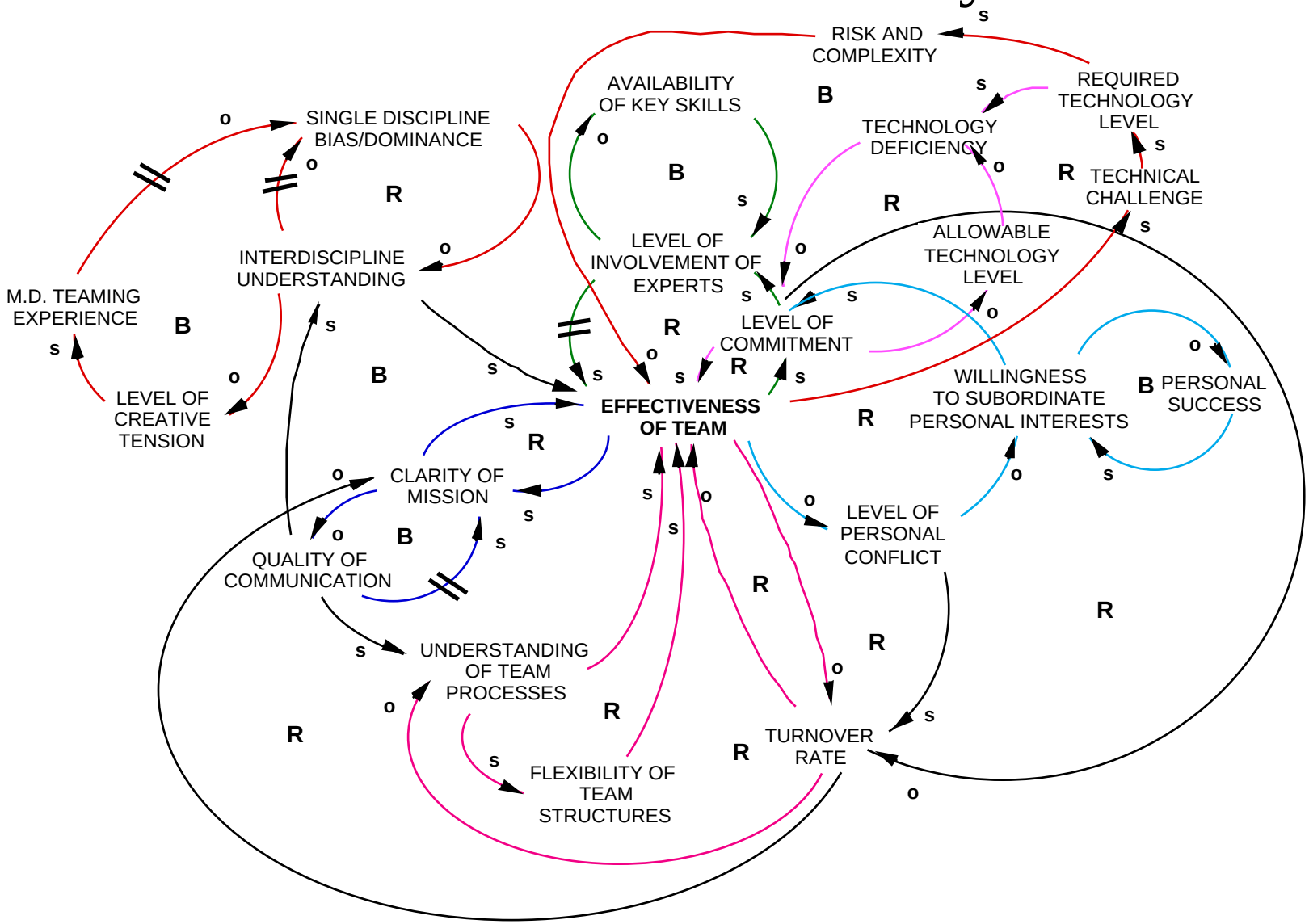
- **A discipline for seeing structures (the patterns and connections) underlying seemingly diverse personal, organizational and societal issues.**
- **Helps us understand and describe complex issues.**
- **Points to higher leverage solutions to problems.**
- **The harder you push, the harder the system pushes back.**
- **The easy way out usually leads back in.**
- **Small changes can produce big results -- but the areas of highest leverage are often the least obvious.**
- **There is no blame.**



LaRC Study Approach

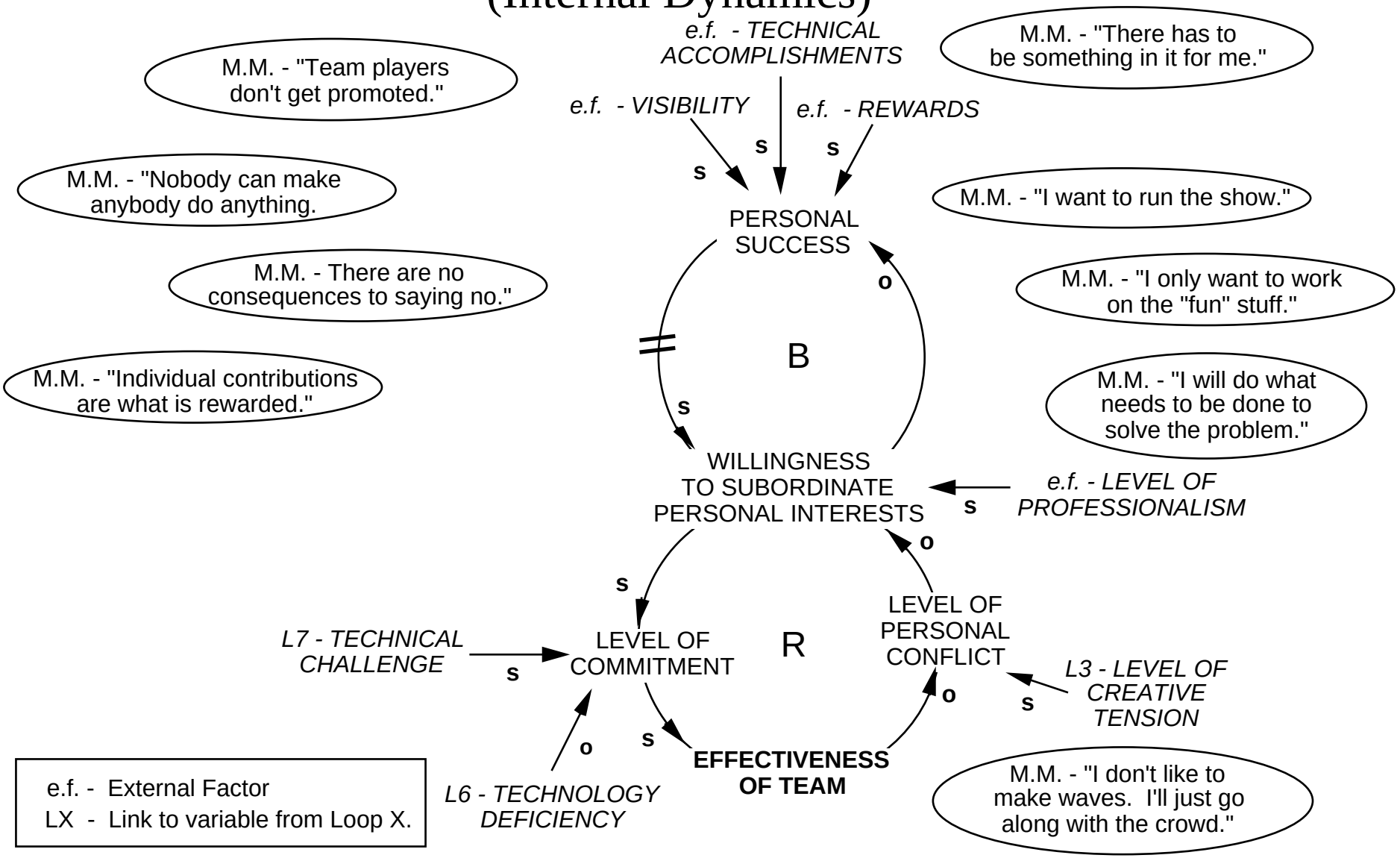
- Select recent multidiscipline teams with a “rich” history
  - Airframe Noise Team (ANT)
  - Longitudinal Controls Alternatives Project (LCAP)
  - MDO Detailed Planning Team
- Interview cross-section of team members to determine influential factors affecting success
- Identify key variables and structural elements affecting team performance
- Distinguish between internal and external dynamics
- Seek causal relationships between key variables that supported the outcomes
- Diagram the causal links and identify archetypical structures that suggest potential interventions
- Identify high-leverage interventions to achieve desired results (long-lasting, self-sustaining, involving choice)

The Whole Internal Story?



Willingness to be a Team Player

(Internal Dynamics)



Willingness to be a Team Player
Key Structures and Interventions

- Key Structures
  - multidisciplinary research often requires willingness to subordinate to team objectives
  - personal success has generally been associated with sophisticated discipline expertise and individual accomplishments

- Potential Interventions
  - link personal success to team success and team participation
    - strengthen structures that support desire to do multidiscipline work
      - rewards, visibility, technical challenges (goals and objectives)
    - emphasize personal benefits of team efforts
      - collaborative synergy, personal satisfaction, new knowledge / capability
    - weaken structures that support single discipline work

Summary of Systems Thinking Study

- Systems Thinking proved a valuable tool in identifying the many complex forces affecting multidisciplinary research teams at LaRC
- The whole story involves over a dozen interconnected diagrams
- The dominant archetype of Internal Dynamics is “Limits to Growth”
- The dominant archetype of External Dynamics is “Success to the Successful”
- System Thinking principles were used to select interventions most appropriate to the archetypes

Status

- Engineering Team Dynamics
  - ETPS was applied to the HSCT4 Team and lessons learned were applied to ELVIS
  - ELVIS will be taking ETPS shortly
  - Efforts to enlist LaRC Office of Human Resources in this tool have so far been unsuccessful
- System Thinking
  - Research & Technology Group senior management was briefed on the whole package, including the recommendations
  - The individual participants continue to benefit from their deeper understanding of multidisciplinary team issues
  - This study remains the only broad application of System Thinking made at LaRC
- Note
  - The Department of the Navy has made extensive use of System Thinking (and Innovation Associates, now part of A. D. Little) for their knowledge management initiative

Teaming Studies References

- Barthelemy, J.-F. M.; Jones, K. M.; Silcox, R. J.; Silva, W. A.; Waszak, M. R.; and Nowaczyk, R. H.: "Charting Multidisciplinary Team External Dynamics Using A Systems Thinking Approach," AIAA Paper 98-4939, 7th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, St. Louis, MO, Sept. 2-4, 1998.
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- Nowaczyk, Ronald H.; and Zang, T. A.: "Factors Related to Successful Engineering Team Design," AIAA Paper 98-4941, 7th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, St. Louis, MO, Sept. 2-4, 1998.